

WE CLAIM AS OUR INVENTION:

1. A method for detecting position changes of a medical implant in a patient, comprising the steps of:

disposing a plurality of x-ray detectable markers in an anatomical environment of an implanted medical implant, said medical implant having x-ray detectable points thereon;

obtaining a first 2D x-ray exposure, from a first projection direction, of a region of the patient containing said implant and said anatomical environment, in which a first distribution of said markers and said points is detectable;

obtaining a second 2D x-ray exposure, from a second 2D x-ray exposure, from a second projection direction different from said first projection direction, of said region at a second point in time, in which a second distribution of said markers and said points is detectable;

electronically detecting said first and second distributions respectively in said first and second 2D x-ray exposures; and

calculating from said first and second distributions, with no 3D reconstruction of spatial positions of said markers and points, a degree of probability that said first and second distribution represent projections of the same three-dimensional distribution of said markers and said points and, from said degree of probability, determining whether a positional change of said implant in the patient has occurred.

2. A method as claimed in claim 1 wherein the step of determining whether said positional change of the implant has occurred comprises defining a degree of probability threshold, and automatically electronically generating an

indication that a positional change of said implant has occurred if said degree of probability does not exceed said threshold.

3. A method as claimed in claim 1 comprising detecting said first and second distributions by digital image processing of the respective first and second 2D x-ray exposures.

4. A method as claimed in claim 1 comprising:

at said first point in time, also obtaining a first calibrated 2D x-ray exposure of said region;

from said first 2D x-ray exposure and said first calibrated 2D x-ray exposure, calculating a first 3D distribution of said markers and points for said first point in time;

at said second point in time, obtaining a second calibrated 2D x-ray exposure of said region;

from said second 2D x-ray exposure and said second calibrated 2D x-ray exposure, calculating a second 3D distribution of said markers and said points for said second point in time; and

comparing said first 3D distribution and said second 3D distribution and, from said comparison, calculating a magnitude of said positional change of said implant, if said position change has occurred.

5. A method as claimed in claim 1 wherein said implant is a prosthesis, and wherein the step of disposing a plurality of x-ray detectable markers in an anatomical environment of said implant comprises disposing a plurality of metal spheres in at least one bone bordering said prosthesis.

6. A method as claimed in claim 1 comprising designating said points of said implant by introducing x-ray detectable markers into said implant.

7. An x-ray system for detecting position changes of a medical implant in a patient, comprising:

a plurality of x-ray detectable markers adapted to be disposed in an anatomical environment of an implanted medical implant, said medical implant having x-ray detectable points thereon;

an x-ray image acquisition apparatus for obtaining a first 2D x-ray exposure, from a first projection direction, of a region of the patient containing said implant and said anatomical environment, in which a first distribution of said markers and said points is detectable, and for obtaining a second 2D x-ray exposure, from a second 2D x-ray exposure, from a second projection direction different from said first projection direction, of said region at a second point in time, in which a second distribution of said markers and said points is detectable;

a device for electronically detecting said first and second distributions respectively in said first and second 2D x-ray exposures; and

a computer for calculating from said first and second distributions, with no 3D reconstruction of spatial positions of said markers and points, a degree of probability that said first and second distribution represent projections of the same three-dimensional distribution of said markers and said points and, from said degree of probability, and for determining whether a positional change of said implant in the patient has occurred.

8. An x-ray system as claimed in claim 7 wherein said computer, for determining whether said positional change of the implant has occurred comprises defines a degree of probability threshold, and automatically electronically generates

an indication that a positional change of said implant has occurred if said degree of probability does not exceed said threshold.

9. An x-ray system as claimed in claim 7 wherein said detection device is a digital image processor.

10. An x-ray system as claimed in claim 7 wherein said x-ray image acquisition apparatus at said first point in time, also obtains a first calibrated 2D x-ray exposure of said region, and wherein said computer, from said first 2D x-ray exposure and said first calibrated 2D x-ray exposure, calculates a first 3D distribution of said markers and points for said first point in time, and wherein said x-ray image acquisition apparatus, at said second point in time, obtains a second calibrated 2D x-ray exposure of said region, and wherein said computer, from said second 2D x-ray exposure and said second calibrated 2D x-ray exposure, calculates a second 3D distribution of said markers and said points for said second point in time, and compares said first 3D distribution and said second 3D distribution and, from said comparison, calculates a magnitude of said positional change of said implant, if said position change has occurred.

11. An x-ray system as claimed in claim 7 wherein said implant is a prosthesis, and wherein said plurality of x-ray detectable markers comprises a plurality of metal spheres adapted for placement in at least one bone bordering said prosthesis.

12. An x-ray system as claimed in claim 7 wherein said points of said implant comprises x-ray detectable markers introduced into said implant.